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TI Bending-resistant, high strength conductive **copper alloy** - contg. tin , **silver** and **indium**, for **wire** and crimped terminals.
DC L03 M26
PA (YAZA) YAZAKI CORP
CYC 1
PI JP 05051675 A 19930302 (199314)* 5p
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A **Cu** billet comprises (by wt.) Sn: 0.4-1.2%, **Ag** :0.1-1.0%, In: 0.1-0.8%, remainder **Cu**.
USE/ADVANTAGE - Used for making conductive **wire** and crimp-style terminals without breaking of **wire**.
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(21)出願番号　特願平3－208249

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(54)【発明の名称】　耐屈曲性に優れた導電性高力銅合金

(57)【要約】

【目的】　導電率が大幅に低下してしまうことのないようにして、機械的衝撃に対し高強度で、圧着端子部における屈曲による断線を減少させること。

【構成】　銅マトリクス中にＳｎを固溶させ、これによって引張り強さを向上し、Ａｇ、Ｉｎを加えることにより導電性を大幅に低下させることなく耐屈曲性を向上させ、伸びも向上させたものである。

1

【特許請求の範囲】

【請求項１】　Ｓｎを０．４～１．２ｗｔ％、Ａｇを０．１～１．０ｗｔ％、Ｉｎを０．１～０．８ｗｔ％含有し、残部が基本的に銅からなる耐屈曲性に優れた導電性高力銅合金。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、銅合金に係わり、特に、例えば自動車用電線の導体等として用いた場合に、導電率の大幅な低下を招くことなく、機械的衝撃に対し高強度で、圧着端子部における引張りおよび屈曲による断線を減少させることのできる耐屈曲性に優れた導電性高力銅合金に関する。

【０００２】

【従来の技術】従来から自動車の自動車用電線の導体としては軟銅線が主として用いられてきた。近年、ＡＴ（オート・トランスミッション）車の普及に伴ってキャブレタから電子燃料噴射装置への転換が図られ、各種計器類等車載装置の電子化が図られている。このような車載装置の電子化等に伴い、自動車内における電気、電子配線回路の数が著しく増加し、自動車内における占積空間が増加し、自動車用電線による自動車総重量の増加を招いている。

【０００３】しかし、自動車の車体は、燃費の向上の点から軽量であることが望ましく、自動車用電線の使用量の増加は、車体の軽量化に逆行することとなる。そこで、車体の軽量化を図る上から、自動車内の配線回路数の増加があっても、自動車内における占積空間の狭小化、及び自動車用電線の総重量の増加の抑制の要望が強まっている。

【０００４】自動車に搭載されるマイクロコンピュータ等に接続し微小電流を流すリード線等は極細い径の電線で充分である。しかし、自動車走行中に生じる振動衝撃が甚だしく大きく、エンジンルーム内が異常な高温となり、充分な機械的強度を有していないと接合部がはずれたり、断線を生じ、自動車走行に支障を生じたりすることがあるため従来は、電気的な必要径より大きな径の導体が用いていた。

【０００５】しかし、充分な機械的強度を確保するため、電気的な必要径より大きな径の導体を用いていたのでは、配線回路数が増加した場合、電気、電子配線回路に用いる自動車用電線の軽量化及び占積空間の狭小化を図ることはできない。

【０００６】そこで、自動車用電線を軽量化するため導体外径を小さくしても機械的強度を確保することのできる硬銅線が検討されたが、硬銅線は材質的に伸びが著しく小さい。このため、硬銅線を用いて端子間を圧着接合しても、自動車走行中に生じる振動衝撃の外力による機械的負荷が接合部に加わると、この接合部が損傷してしまうことがある。このように硬銅線を用いて端子間を圧着接合すると、端子圧着箇所が機械的な弱点部となり外的衝撃によって断線を生じやすく信頼性に乏しいという結果を招来している。

2

【０００７】また、自動車用電線の使用重量を小さくすることは、導体径を小さくすることによって実現が可能であるが、従来の如き硬銅線にあっては、導体外径を小さくすると機械的強度が低下してしまう。そこで、近年、導体外径を小さくしても、機械的強度を確保でき、比較的良好な繰り返し屈曲強度及び導電性を有する銅合金としてＳｎを含有する銅合金、Ｍｇ－Ｐ銅合金等発明されている。

【０００８】

【発明が解決しようとする課題】このＳｎを含有する銅合金は、Ｓｎを銅マトリクス中に固溶させることにより、引張り強さ及び伸びを向上させたものである。しかしながら、このＳｎを含有する銅合金は、自動車走行中に生じる振動衝撃等の外力による機械的負荷に耐え得るに充分な耐屈曲性が充分でないという問題点を有している。

【０００９】また、Ｍｇ－Ｐ銅合金は、Ｍｇ－Ｐの金属間化合物を、銅マトリクス中に析出させることにより、導電性を大きく低下させずに、引張り強さ及び伸びを向上させたものである。しかしながら、このＭｇ－Ｐ銅合金は、自動車走行中に生じる振動衝撃等の外力による機械的負荷に耐え得るに充分な耐屈曲性が充分でないという問題点を有している。

【００１０】本発明は、導電率の大幅な低下を招くことなく、機械的衝撃に対し高強度で、圧着端子部における屈曲による断線を減少させることのできる耐屈曲性に優れた導電性高力銅合金を提供することを目的としている。

【００１１】

【課題を解決するための手段】上記目的を達成するために、本発明の耐屈曲性に優れた導電性高力銅合金においては、Ｓｎを０．４～１．２ｗｔ％、Ａｇを０．１～１．０ｗｔ％、Ｉｎを０．１～０．８ｗｔ％含有し、残部が基本的に銅によって構成したものである。

【００１２】すなわち、上記目的を達成するために、本発明の耐屈曲性に優れた導電性高力銅合金においては、銅マトリクス中にＳｎを固溶させ、これによって引張り強さを向上し、Ａｇ、Ｉｎを加えることにより導電性を大幅に低下させることなく耐屈曲性を向上させ、伸びも向上させたものである。

【００１３】本発明において、Ｓｎの含有量を０．４～１．２ｗｔ％、としたのは、Ｓｎの含有量が０．４ｗｔ％未満では、引張り強さを向上させる効果が小さく、Ｓｎの含有量が１．２ｗｔ％を超えると、大幅に導電性を低下させるためである。

【００１４】また、本発明において、Ａｇの含有量を０．１～１．０ｗｔ％、としたのは、Ａｇの含有量が

3

0．1wt％未満では、引張り強さ及び耐屈曲性を向上させる効果が小さく、Agの含有量が1．0wt％を超えると、鋳造性が悪化すると共にコスト高となるためである。

【0015】さらに、本発明において、Inの含有量を0．1～0．8wt％、としたのは、Inの含有量が0．1wt％未満では、引張り強さ、伸び、耐屈曲性を向上させる効果が低く、Inの含有量が0．8wt％を超えると大幅に導電性を低下させるためである。

【0016】

【作用】上記のように構成された耐屈曲性に優れた導電性高力銅合金を用いると、導電率は、従来の導電性高力銅合金とほぼ同等の導電率を有することができる。

【0017】また、上記のように構成された耐屈曲性に優れた導電性高力銅合金を用いると、引張り強さは、硬銅の約1．3倍以上と飛躍的強さを有し、従来の導電性高力銅合金に比してもやや向上させることができる。

【0018】さらに、上記のように構成された耐屈曲性に優れた導電性高力銅合金を用いると、伸びは、軟銅より小さくなるが、硬銅に比して6倍以上の伸びを有しており、軟銅と同等以上の繰返し屈曲強度を得ることができる。さらに、伸びは、従来の導電性高力銅合金に比しても若干の向上を示している。

【0019】そして、上記した理由から本発明のように構成された耐屈曲性に優れた導電性高力銅合金を自動車用電線に用いた場合に、自動車用電線の導体に適した特性を得ることができ、胴体外径の小型かに対する機械的強度の確保と端子圧着箇所での引張加重及び屈曲による断線を減少させることができる。したがって、上記のように構成された耐屈曲性に優れた導電性高力銅合金を電

4

子機器内配線用電線の導体、半導体のリード線材等として用いると好適である。

【0020】

【実施例】以下、本願発明の具体的実施例について従来例と比較して説明する。

【0021】本発明の実施例として、不活性ガス雰囲気に保たれた溶解炉で、黒鉛粒被覆下にて銅を溶解した後、Sn、Ag、Inを純金属の形態で添加し、均一な溶湯を得、これを連続鋳造により表1に示す如き各実施例の組成の20mmφの鋳造棒を作成した。これらを冷間圧延、伸線により1．0mmφにした後、不活性ガス雰囲気の電気炉を用い、280℃で2時間の熱処理した。その後、引張り強さ、伸び、導電率、繰返し屈曲強度を測定した。比較例も同様の製造方法によったものである。

【0022】なお、屈曲試験は、図1に示す如く、治具1に供試材2を挟持し、他端を2kgの引張荷重Wを加えた状態で図1に図示（A）→（B）→（C）→（D）と左右90°曲げを1回として破断するまで、繰返し行い、その回数を繰返し屈曲強度とした。

【0023】表1には、本発明に係る耐屈曲性に優れた導電性高力銅合金の特徴を明確にするために、実施例と合わせて、比較例及び従来例の組成、特性値が示してある。

【0024】なお、比較例の合金No3～No5は、組成がNi、Si、In、Snと本発明と同一であるが、各組成の含有量が本発明とは異なっている。

【0025】

【表1】

	合金No	組成 (wt%) Sn	Ag	In	Mg	P	Cu	導電率 (%IACS)	引張強さ (kg/mm^2)	伸び率 (%)	繰返し屈曲強度 (回数)
実施例	1	0.47	0.46	0.75	—	—	残	47	64	5.6	42
	2	0.62	0.32	0.54	—	—	残	48	61	4.9	40
	3	0.85	0.86	0.18	—	—	残	48	60	5.2	41
	4	0.98	0.54	0.47	—	—	残	46	62	5.3	41
	5	1.14	0.18	0.23	—	—	残	45	65	5.0	40
比較例	1	1.38	—	—	—	—	残	45	55	2.4	34
	2	0.32	—	—	0.49	0.21	残	55	57	5.8	33
	3	1.68	0.36	0.78	—	—	残	36	68	4.9	40
	4	0.86	0.03	0.46	—	—	残	48	57	4.5	35
	5	0.64	0.61	0.03	—	—	残	51	60	4.1	35
従来例	硬銅	—	—	—	—	—	残	98.3	49.8	0.9	19
	軟銅	—	—	—	—	—	残	100.3	23.3	27.3	41

【0026】表1の実施例（No1～No5）と比較例（No1～No5）との比較から明らかな如く、本発明によるとSnを銅マトリクス中に固溶させることにより、引張強さを向上させることができる。

【0027】また、本発明によるとCu母相中にAg、Inを固溶させているため、このCu母相中へのAg、Inの固溶により、導電率を低下させることなく、引張り強さ、伸び特性、耐屈曲性を飛躍的に向上させることができる。この導電率は、Cu母相中に固溶したAg、Inにより比較例（No2）に比して低下はあるが、約45%IACS以上を確保し、引張り強さは硬銅より格段向上（硬銅の約1．3倍）することができ、繰返し屈曲強度は軟銅と同等の向上を示し、伸び率に至っては比較例（No1）の約2倍、比較例（No2）と同等の値を示している。このように、本発明に係る耐屈曲性に優れた導電性高力銅合金は、導電率においては、比較例（No2）より劣るも約45%IACSを示し、比較例（No1）よりは勝り、引張り強さにおいては、比較例

7

（Ｎｏ１、Ｎｏ２）より勝り、伸びにおいては、比較例（Ｎｏ２）と同等の特性を示し、比較例（Ｎｏ１）より数段勝り、繰返し強度に至っては、比較例（Ｎｏ１、Ｎｏ２）より数段優れた特性を有し、極めて良好な軟銅と同等の特性を有している。

【００２８】したがって、本発明に係る耐屈曲性に優れた導電性高力銅合金は、自動車用電線の導体に適した特性を有し、導体外径の小型、軽量化に対応した機械的強度を確保し、圧着端子部における引張り及び屈曲による断線を減少させることができる。このことから、上記のように構成された耐屈曲性に優れた導電性高力銅合金を電子機器内配線用電線の導体、半導体のリード線材等として用いると好適である。

8

【００２９】

【発明の効果】本発明によれば、導電率の大幅な低下を招くことなく、機械的衝撃に対し高強度で、圧着端子部における屈曲による断線を減少させることができる。

【図面の簡単な説明】

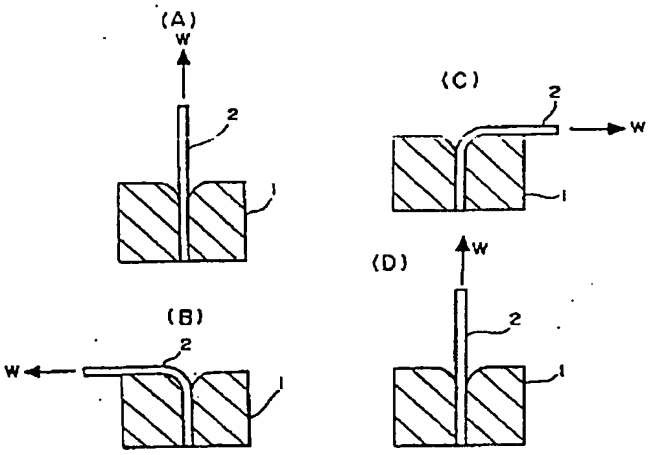
【図１】本発明の実施例及び比較例、従来例の屈曲試験方法を示す図である。

【符号の説明】

１……治具

２……供試材

【図１】



フロントページの続き

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【構成】　銅マトリクス中にＳｎを固溶させ、これによって引張り強さを向上し、Ａｇ、Ｉｎを加えることにより導電性を大幅に低下させることなく耐屈曲性を向上させ、伸びも向上させたものである。

1

【特許請求の範囲】

【請求項1】　Snを0．4～1．2wt%、Agを0．1～1．0wt%、Inを0．1～0．8wt%含有し、残部が基本的に銅からなる耐屈曲性に優れた導電性高力銅合金。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、銅合金に係わり、特に、例えば自動車用電線の導体等として用いた場合に、導電率の大幅な低下を招くことなく、機械的衝撃に対し高強度で、圧着端子部における引張りおよび屈曲による断線を減少させることのできる耐屈曲性に優れた導電性高力銅合金に関する。

【0002】

【従来の技術】従来から自動車の自動車用電線の導体としては軟銅線が主として用いられてきた。近年、AT（オート・トランスミッション）車の普及に伴ってキャブレタから電子燃料噴射装置への転換が図られ、各種計器類等車載装置の電子化が図られている。このような車載装置の電子化等に伴い、自動車内における電気、電子配線回路の数が著しく増加し、自動車内における占積空間が増加し、自動車用電線による自動車総重量の増加を招いている。

【0003】しかし、自動車の車体は、燃費の向上の点から軽量であることが望ましく、自動車用電線の使用量の増加は、車体の軽量化に逆行することとなる。そこで、車体の軽量化を図る上から、自動車内の配線回路数の増加があっても、自動車内における占積空間の狭小化、及び自動車用電線の総重量の増加の抑制の要望が強まっている。

【0004】自動車に搭載されるマイクロコンピュータ等に接続し微小電流を流すリード線等は極細い径の電線で充分である。しかし、自動車走行中に生じる振動衝撃が甚だしく大きく、エンジンルーム内が異常な高温となり、充分な機械的強度を有していないと接合部がはずれたり、断線を生じ、自動車走行に支障を生じたりすることがあるため従来は、電気的な必要径より大きな径の導体が用いていた。

【0005】しかし、充分な機械的強度を確保するため、電気的な必要径より大きな径の導体を用いていたのでは、配線回路数が増加した場合、電気、電子配線回路に用いる自動車用電線の軽量化及び占積空間の狭小化を図ることはできない。

【0006】そこで、自動車用電線を軽量化するため導体外径を小さくしても機械的強度を確保することのできる硬銅線が検討されたが、硬銅線は材質的に伸びが著しく小さい。このため、硬銅線を用いて端子間を圧着接合しても、自動車走行中に生じる振動衝撃の外力による機械的負荷が接合部に加わると、この接合部が損傷してしまうことがある。このように硬銅線を用いて端子間を圧

2

着接合すると、端子圧着箇所が機械的な弱点部となり外的衝撃によって断線を生じやすく信頼性に乏しいという結果を招来している。

【0007】また、自動車用電線の使用重量を小さくすることは、導体径を小さくすることによって実現が可能であるが、従来の如き硬銅線にあっては、導体外径を小さくすると機械的強度が低下してしまう。そこで、近年、導体外径を小さくしても、機械的強度を確保でき、比較的良好な繰り返し屈曲強度及び導電性を有する銅合金としてSnを含有する銅合金、Mg－P銅合金等発明されている。

【0008】

【発明が解決しようとする課題】このSnを含有する銅合金は、Snを銅マトリクス中に固溶させることにより、引張り強さ及び伸びを向上させたものである。しかしながら、このSnを含有する銅合金は、自動車走行中に生じる振動衝撃等の外力による機械的負荷に耐え得るに充分な耐屈曲性が充分でないという問題点を有している。

【0009】また、Mg－P銅合金は、Mg－Pの金属間化合物を、銅マトリクス中に析出させることにより、導電性を大きく低下させずに、引張り強さ及び伸びを向上させたものである。しかしながら、このMg－P銅合金は、自動車走行中に生じる振動衝撃等の外力による機械的負荷に耐え得るに充分な耐屈曲性が充分でないという問題点を有している。

【0010】本発明は、導電率の大幅な低下を招くことなく、機械的衝撃に対し高強度で、圧着端子部における屈曲による断線を減少させることのできる耐屈曲性に優れた導電性高力銅合金を提供することを目的としている。

【0011】

【課題を解決するための手段】上記目的を達成するために、本発明の耐屈曲性に優れた導電性高力銅合金においては、Snを0．4～1．2wt%、Agを0．1～1．0wt%、Inを0．1～0．8wt%含有し、残部が基本的に銅によって構成したものである。

【0012】すなわち、上記目的を達成するために、本発明の耐屈曲性に優れた導電性高力銅合金においては、銅マトリクス中にSnを固溶させ、これによって引張り強さを向上し、Ag、Inを加えることにより導電性を大幅に低下させることなく耐屈曲性を向上させ、伸びも向上させたものである。

【0013】本発明において、Snの含有量を0．4～1．2wt%、としたのは、Snの含有量が0．4wt%未満では、引張り強さを向上させる効果が小さく、Snの含有量が1．2wt%を超えると、大幅に導電性を低下させるためである。

【0014】また、本発明において、Agの含有量を0．1～1．0wt%、としたのは、Agの含有量が

3

0．1wt％未満では、引張り強さ及び耐屈曲性を向上させる効果が小さく、Agの含有量が1．0wt％を超えると、鋳造性が悪化すると共にコスト高となるためである。

【0015】さらに、本発明において、Inの含有量を0．1～0．8wt％、としたのは、Inの含有量が0．1wt％未満では、引張り強さ、伸び、耐屈曲性を向上させる効果が低く、Inの含有量が0．8wt％を超えると大幅に導電性を低下させるためである。

【0016】

【作用】上記のように構成された耐屈曲性に優れた導電性高力銅合金を用いると、導電率は、従来の導電性高力銅合金とほぼ同等の導電率を有することができる。

【0017】また、上記のように構成された耐屈曲性に優れた導電性高力銅合金を用いると、引張り強さは、硬銅の約1．3倍以上と飛躍的強さを有し、従来の導電性高力銅合金に比してもやや向上させることができる。

【0018】さらに、上記のように構成された耐屈曲性に優れた導電性高力銅合金を用いると、伸びは、軟銅より小さくなるが、硬銅に比して6倍以上の伸びを有しており、軟銅と同等以上の繰返し屈曲強度を得ることができる。さらに、伸びは、従来の導電性高力銅合金に比しても若干の向上を示している。

【0019】そして、上記した理由から本発明のように構成された耐屈曲性に優れた導電性高力銅合金を自動車用電線に用いた場合に、自動車用電線の導体に適した特性を得ることができ、胴体外径の小型かに対する機械的強度の確保と端子圧着箇所での引張加重及び屈曲による断線を減少させることができる。したがって、上記のように構成された耐屈曲性に優れた導電性高力銅合金を電

4

子機器内配線用電線の導体、半導体のリード線材等として用いると好適である。

【0020】

【実施例】以下、本願発明の具体的実施例について従来例と比較して説明する。

【0021】本発明の実施例として、不活性ガス雰囲気に保たれた溶解炉で、黒鉛粒被覆下にて銅を溶解した後、Sn、Ag、Inを純金属の形態で添加し、均一な溶湯を得、これを連続鋳造により表1に示す如き各実施例の組成の20mmφの鋳造棒を作成した。これらを冷間圧延、伸線により1．0mmφにした後、不活性ガス雰囲気の電気炉を用い、280℃で2時間の熱処理した。その後、引張り強さ、伸び、導電率、繰返し屈曲強度を測定した。比較例も同様の製造方法によったものである。

【0022】なお、屈曲試験は、図1に示す如く、治具1に供試材2を挟持し、他端を2kgの引張荷重Wを加えた状態で図1に図示（A）→（B）→（C）→（D）と左右90°曲げを1回として破断するまで、繰返し行い、その回数を繰返し屈曲強度とした。

【0023】表1には、本発明に係る耐屈曲性に優れた導電性高力銅合金の特徴を明確にするために、実施例と合わせて、比較例及び従来例の組成、特性値が示してある。

【0024】なお、比較例の合金No3～No5は、組成がNi、Si、In、Snと本発明と同一であるが、各組成の含有量が本発明とは異なっている。

【0025】

【表1】

	合金No	組成 (wt%) Sn	Ag	In	Mg	P	Cu	導電率 (%IACS)	引張強さ (kg/mm²)	伸び率 (%)	繰返し屈曲強度 (回数)
実施例	1	0.47	0.46	0.75	—	—	残	47	64	5.6	42
	2	0.62	0.32	0.54	—	—	残	48	61	4.9	40
	3	0.85	0.86	0.18	—	—	残	48	60	5.2	41
	4	0.98	0.54	0.47	—	—	残	46	62	5.3	41
	5	1.14	0.18	0.23	—	—	残	45	65	5.0	40
比較例	1	1.38	—	—	—	—	残	45	55	2.4	34
	2	0.32	—	—	0.49	0.21	残	55	57	5.8	33
	3	1.68	0.36	0.78	—	—	残	36	68	4.9	40
	4	0.86	0.03	0.46	—	—	残	48	57	4.5	35
	5	0.64	0.61	0.03	—	—	残	51	60	4.1	35
従来例	硬銅	—	—	—	—	—	残	98.3	49.8	0.9	19
	軟銅	—	—	—	—	—	残	100.3	23.3	27.3	41

【0026】表1の実施例（No1～No5）と比較例（No1～No5）との比較から明らかな如く、本発明によるとSnを銅マトリクス中に固溶させることにより、引張強さを向上させることができる。

【0027】また、本発明によるとCu母相中にAg、Inを固溶させているため、このCu母相中へのAg、Inの固溶により、導電率を低下させることなく、引張り強さ、伸び特性、耐屈曲性を飛躍的に向上させることができる。この導電率は、Cu母相中に固溶したAg、Inにより比較例（No2）に比して低下はあるが、約45%IACS以上を確保し、引張り強さは硬銅より格段向上（硬銅の約1．3倍）することができ、繰返し屈曲強度は軟銅と同等の向上を示し、伸び率に至っては比較例（No1）の約2倍、比較例（No2）と同等の値を示している。このように、本発明に係る耐屈曲性に優れた導電性高力銅合金は、導電率においては、比較例（No2）より劣るも約45%IACSを示し、比較例（No1）よりは勝り、引張り強さにおいては、比較例

7

（No1、No2）より勝り、伸びにおいては、比較例（No2）と同等の特性を示し、比較例（No1）より数段勝り、繰返し強度に至っては、比較例（No1、No2）より数段優れた特性を有し、極めて良好な軟銅と同等の特性を有している。

【0028】したがって、本発明に係る耐屈曲性に優れた導電性高力銅合金は、自動車用電線の導体に適した特性を有し、導体外径の小型、軽量化に対応した機械的強度を確保し、圧着端子部における引張り及び屈曲による断線を減少させることができる。このことから、上記のように構成された耐屈曲性に優れた導電性高力銅合金を電子機器内配線用電線の導体、半導体のリード線材等と

8

して用いると好適である。

【0029】

【発明の効果】本発明によれば、導電率の大幅な低下を招くことなく、機械的衝撃に対し高強度で、圧着端子部における屈曲による断線を減少させることができる。

【図面の簡単な説明】

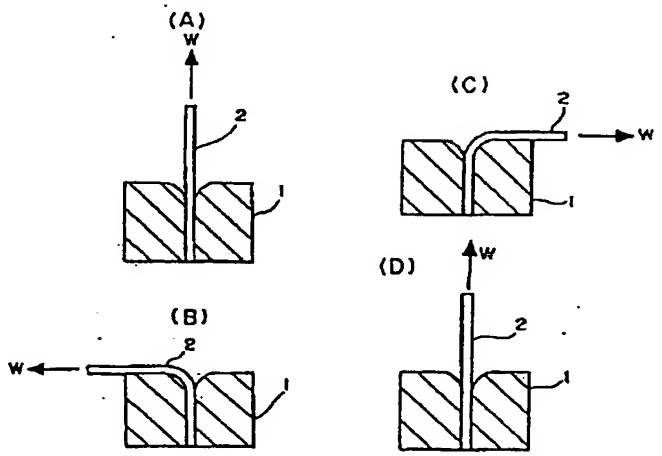
【図1】本発明の実施例及び比較例、従来例の屈曲試験方法を示す図である。

【符号の説明】

1……治具

2……供試材

【図1】



フロントページの続き

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PATENT ABSTRACTS OF JAPAN

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NISHIJIMA TAMOTSU
FUJINO TOSHIHIRO
TAKI YASUHITO

) CONDUCTIVE HIGH STRENGTH COPPER ALLOY EXCELLENT IN BENDING RESISTANCE

)Abstract:

RPOSE: To obtain a copper alloy having electric conductivity practically equal to that of the conventional ɛ, improved in strength against mechanical impacts, and capable of reducing the breakage of wire due to ıding at the crimp-style terminal area by adding specific amounts of Ag and In to a copper alloy ıtaining specific amounts of Sn.

NSTITUTION: This conductive high strength copper alloy has a composition consisting of, by weight, -1.2% Sn, 0.1-1.0% Ag, 0.1-0.8% In, and the balance copper and also has superior bending resistance. ıis copper alloy, bending resistance is improved and also elongation is improved without causing ıarkable deterioration in electric conductivity by adding Ag and In to Sn-containing copper. The tensile ıgth improving effect is decreased when n content is below the lower limit, and electric conductivity is ıarkably reduced when it exceeds the upper limit. The effects of improving tensile strength and bending stance are decreased when Ag content is below the lower limit, and castability is deteriorated when it eeds the upper limit. Further, the effects of improving tensile strength, elongation, and bendability are reased when In content is below the lower limit, and electric conductivity is remarkably reduced when it eeds the upper limit.

AL STATUS

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TAILED DESCRIPTION

tailed Description of the Invention]
01]
dustrial Application] Without causing the sharp decline in conductivity, when it uses as a conductor of for example, electric wire for automobiles etc. with respect to a copper alloy, to a mechanical shock, especially this invention is h intensity and relates to the conductive Koriki copper alloy excellent in the flexibility which can decrease the open uit by the tension and incurvation in the pressure-connection-terminal section.
02]
scription of the Prior Art] As a conductor of the electric wire for automobiles of an automobile, annealed copper e has mainly been used from the former. In recent years, conversion to an electronic fuel injection equipment from a uretor is achieved with the spread of AT (auto transmission) vehicles, and electronic processing of mounted ipments, such as various instruments, is attained. With electronic processing of such mounted equipment etc., the ıber of the electrical and electric equipment in automatic in the car and electronic wiring circuits increased arkably, the fortune-telling product space in automatic in the car increased, and the increase in G.V.W. with the tric wire for automobiles is caused.
03] However, the body of an automobile will have a desirable lightweight thing from the point of improvement in , and the increase in the amount of the electric wire for automobiles used will move against lightweight-ization of body. Then, even if there is an increase in the upper shell and the number of wiring circuits automatic in the car ch attain lightweight-ization of the body, narrow-izing of the fortune-telling product space in automatic in the car the request of suppression of the increase in the AUW of the electric wire for automobiles have become strong.
04] The electric wire of the diameter of a narrow is very enough as the lead wire which connects with the rocomputer carried in an automobile and passes minute current. However, the oscillating shock produced during an mobile run was greatly great, and since a joint may have separated, or an open circuit may have been produced and ble may have been produced to an automobile run if the inside of an engine room serves as an unusual elevated perature and does not have sufficient mechanical strength, the conductor of a bigger path than the electric diameter equired used conventionally.
05] However, by having used the conductor of a bigger path than the electric diameter of required, since sufficient hanical strength is secured, when the number of wiring circuits increases, lightweight-izing of the electric wire for mobiles used for the electrical and electric equipment and an electronic wiring circuit and narrow-ization of a ıne-telling product space cannot be attained.
06] in order [then,] to lightweight-ize the electric wire for automobiles -- a conductor -- although the hard drawn per wire which can secure a mechanical strength was examined even if it made the outer diameter small, elongation ard drawn copper wire is remarkably small in quality of the material For this reason, this joint may be damaged, n the mechanical load by the external force of the oscillating shock produced during an automobile run joins a , even if it carries out sticking-by-pressure junction of between terminals using hard drawn copper wire. Thus, if ing-by-pressure junction of between terminals is carried out using hard drawn copper wire, the terminal sticking- ressure part would become the mechanical weak point section, and the result of being scarce will be invited to bility that it is easy to produce an open circuit by the external shock.
07] moreover, the thing for which the operating weight of the electric wire for automobiles is made small -- a luctor -- although it is realizable by making a path small, if it is in the conventional **** hard drawn copper wire -- nductor -- if an outer diameter is made small, a mechanical strength will fall then, recent years and a conductor -- ı if it makes an outer diameter small, a mechanical strength can be secured and a copper alloy, a Mg-P copper alloy, which contain Sn as a copper alloy which has comparatively good repeat incurvation intensity and conductivity are nted

8]
blem(s) to be Solved by the Invention] The copper alloy containing this Sn raises tensile strength and elongation by ing Sn dissolve in a copper matrix. However, the copper alloy containing this Sn has the trouble that sufficient bility to be able to bear the mechanical load by external force, such as an oscillating shock produced during an mobile run, is not enough.
9] Moreover, a Mg-P copper alloy raises tensile strength and elongation by depositing the intermetallic compound lg-P in a copper matrix, without reducing conductivity greatly. However, this Mg-P copper alloy has the trouble sufficient flexibility to be able to bear the mechanical load by external force, such as an oscillating shock produced ig an automobile run, is not enough.
0] Without causing the sharp decline in conductivity, to the mechanical shock, this invention is high intensity and at offering the conductive Koriki copper alloy excellent in the flexibility which can decrease the open circuit by rookedness in the pressure-connection-terminal section.
1]
ins for Solving the Problem] the conductive Koriki copper alloy which was excellent in the flexibility of this ition in order to attain the above-mentioned purpose -- setting -- Sn -- 0.4 - 1.2wt% and Ag -- 0.1 - 1.0wt% and In l - 0.8wt% -- it contains and the remainder constitutes with copper fundamentally
2] That is, in order to attain the above-mentioned purpose, in the conductive Koriki copper alloy excellent in the bility of this invention, Sn is made to dissolve in a copper matrix, tensile strength is improved by this, flexibility is d without reducing conductivity sharply by adding Ag and In, and elongation is also raised.
3] In this invention, the content of Sn was made into 0.4 - 1.2wt% for reducing conductivity sharply, when the t that the content of Sn raises tensile strength less than [0.4wt%] is small and the content of Sn exceeded 1.2wt

4] Moreover, if the effect that the content of Ag raises tensile strength and flexibility less than [0.1wt%] was l and the content of Ag exceeded 1.0wt(s)%, while fluidity would get worse, in this invention, the content of Ag nade into 0.1 - 1.0wt%, because it became cost quantity.
5] Furthermore, in this invention, the content of In was made into 0.1 - 0.8wt% for reducing conductivity sharply, i the effect that the content of In raises tensile strength, elongation, and flexibility less than [0.1wt%] is low and ontent of In exceeded 0.8wt(s)%.
5]
ction] If the conductive Koriki copper alloy excellent in the flexibility constituted as mentioned above is used, uctivity can have conductivity almost equivalent to the conventional conductive Koriki copper alloy.
7] Moreover, if the conductive Koriki copper alloy excellent in the flexibility constituted as mentioned above is tensile strength has about 1.3 or more times and the fast strength of a hard steel, and even if it compares with the entional conductive Koriki copper alloy, it can be raised a little.
3] Furthermore, if the conductive Koriki copper alloy excellent in the flexibility constituted as mentioned above is although elongation becomes smaller than annealed copper, it has the elongation of 6 times or more as compared the hard steel, and can obtain annealed copper and the recurrence crookedness intensity more than equivalent. ermore, even if it compares elongation with the conventional conductive Koriki copper alloy, it shows the ovement in some.
)] And since it described above, when the conductive Koriki copper alloy excellent in the flexibility constituted his invention is used for the electric wire for automobiles, the property suitable for the conductor of the electric for automobiles can be acquired, and the open circuit by a **** load and crookedness in reservation of the anical strength to whether a fuselage outer diameter is small and a terminal sticking-by-pressure part can be ased. Therefore, it is suitable if the conductive Koriki copper alloy excellent in the flexibility constituted as ioned above is used as a lead wire rod of the conductor of the electric wire for the wiring in electronic equipment, semiconductor etc.
)]
nple] Hereafter, the concrete example of the invention in this application is explained as compared with the entional example.
l] As an example of this invention, with the fusion furnace maintained at inert gas atmosphere, after dissolving er under graphite grain covering, Sn, Ag, and In were added with the form of a pure metal, the uniform molten l was obtained, and the casting rod of 20mmphi of composition of **** each example which shows this in Table 1 ntinuous casting was created. the electric furnace of the inert gas atmosphere after setting these to 1.0mmphi by rolling and the wire drawing -- using -- 280 degrees C -- 2 hours -- it heat-treated Then, tensile strength, ation, conductivity, and recurrence crookedness intensity were measured. The example of comparison is also

ended on the same manufacture method.
22] In addition, as shown in drawing 1 , the incurvation examination pinched the test specimen 2 to the fixture 1, eated a recurrence deed and its number of times, and was made into incurvation intensity until it fractured ıstration A) ->(B) ->(C) -> (D) and 90 degree [of right and left] bending as 1 time to drawing 1 , where the tension d W of 2kg is applied for the other end.
23] In order to clarify the feature of the conductive Koriki copper alloy excellent in the flexibility concerning this ention, together with the example, composition of the example of comparison and the conventional example and ghted solidity are shown in Table 1.
24] In addition, although composition of the alloys No3-No5 of the example of comparison is the same as that of cel, Si, In, Sn, and this invention, the content of each composition differs from this invention.
25]
ble 1]

	No	Sn	Ag	In	Mg	P	Cu	導電率 (%IACS)	引張強さ (kg/mm²)	伸び率 (%)	繰返し屈曲強度 (回数)
実施例	1	0.47	0.46	0.75	—	—	残	47	64	5.6	42
	2	0.62	0.32	0.54	—	—	残	48	61	4.9	40
	3	0.85	0.86	0.18	—	—	残	48	60	5.2	41
	4	0.98	0.54	0.47	—	—	残	46	62	5.3	41
	5	1.14	0.18	0.23	—	—	残	45	65	5.0	40
比較例	1	1.38	—	—	—	—	残	45	55	2.4	34
	2	0.32	—	—	0.49	0.21	残	55	57	5.8	33
	3	1.68	0.36	0.78	—	—	残	36	68	4.9	40
	4	0.86	0.03	0.46	—	—	残	48	57	4.5	35
	5	0.64	0.61	0.03	—	—	残	51	60	4.1	35
従来	硬銅	—	—	—	—	—	残	98.3	49.8	0.9	19
	軟銅	—	—	—	—	—	残	100.3	23.3	27.3	41

26] According to this invention, tensile strength can be raised by making Sn dissolve in a copper matrix so that
ırly from comparison with the example (No1-No5) of Table 1, and the example of comparison (No1-No5).
27] Moreover, since Ag and In are made to dissolve in Cu host phase according to this invention, tensile strength, an
ıgation property, and flexibility can be raised by leaps and bounds by dissolution of Ag to the inside of this Cu host
se, and In, without reducing conductivity. although there is a fall as compared with the example of comparison
2) by Ag and In to which this conductivity dissolved in Cu host phase -- more than about 45%IACS -- securing --
ile strength -- a hard steel -- markedly -- improvement (about 1.3 times of a hard steel) -- it can carry out --
ırrence incurvation intensity -- ****** -- equivalent improvement is shown, and if it results in a pace of expansion,
value equivalent to the twice of the example of comparison (No1) and the example of comparison (No2) is Thus,

conductive Koriki copper alloy excellent in the flexibility concerning this invention IACS is shown about 45%, el rather than the example of comparison (No1), and it sets to tensile strength. conductivity -- setting -- the example omparison (No2) -- being also inferior -- It excels from the example of comparison (No1, No2), in elongation, a perty equivalent to the example of comparison (No2) is shown, and if several steps excel and it results in recurrence nsity from the example of comparison (No1), from the example of comparison (No1, No2), it has the property ch was excellent several steps, and has the property equivalent to very good annealed copper.

28] therefore, the property to which the conductive Koriki copper alloy excellent in the flexibility concerning this ntion was suitable for the conductor of the electric wire for automobiles -- having -- a conductor -- small [of an r diameter] and the mechanical strength corresponding to lightweight-izing can be secured, and the open circuit by tension and incurvation in the pressure-connection-terminal section can be decreased It is suitable if the conductive iki copper alloy which was excellent in the flexibility constituted as mentioned above from this is used as a lead rod of the conductor of the electric wire for the wiring in electronic equipment, and a semiconductor etc.

29]

ect of the Invention] According to this invention, the open circuit by the incurvation in the pressure-connection-inal section can be decreased with high intensity to a mechanical shock, without causing the sharp decline in luctivity.

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TECHNICAL FIELD

[Industrial Application] Without causing the sharp decline in conductivity, when it uses as a conductor of for exampl the electric wire for automobiles etc. with respect to a copper alloy, to a mechanical shock, especially this invention i high intensity and relates to the conductive Koriki copper alloy excellent in the flexibility which can decrease the ope circuit by the tension and the crookedness in the pressure-connection-terminal section.

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OR ART

scription of the Prior Art] As a conductor of the electric wire for automobiles of an automobile, annealed copper
: has mainly been used from the former. In recent years, conversion to an electronic fuel injection equipment from a
uretor is achieved with the spread of AT (auto transmission) vehicles, and electronic processing of mounted
pments, such as various instruments, is attained. With electronic processing of such mounted equipment etc., the
ber of the electrical and electric equipment in automatic in the car and electronic wiring circuits increased
arkably, the fortune-telling product space in automatic in the car increased, and the increase in G.V.W. with the
tric wire for automobiles is caused.
3] However, the body of an automobile will have a desirable lightweight thing from the point of improvement in
, and the increase in the amount of the electric wire for automobiles used will move against lightweight-ization of
ody. Then, even if there is an increase in the upper shell and the number of wiring circuits automatic in the car
:h attain lightweight-ization of the body, narrow-izing of the fortune-telling product space in automatic in the car
the request of suppression of the increase in the AUW of the electric wire for automobiles have become strong.
4] The electric wire of the diameter of a narrow is very enough as the lead wire which connects with the
ocomputer carried in an automobile and passes minute current. However, the oscillating shock produced during an
mobile run was greatly great, and since a joint may have separated, or an open circuit may have been produced and
le may have been produced to an automobile run if the inside of an engine room serves as an unusual elevated
erature and does not have sufficient mechanical strength, the conductor of a bigger path than the electric diameter
quired used conventionally.
5] However, by having used the conductor of a bigger path than the electric diameter of required, since sufficient
anical strength is secured, when the number of wiring circuits increases, lightweight-izing of the electric wire for
nobiles used for the electrical and electric equipment and an electronic wiring circuit and narrow-ization of a
ne-telling product space cannot be attained.
5] in order [then,] to lightweight-ize the electric wire for automobiles -- a conductor -- although the hard drawn
er wire which can secure a mechanical strength was examined even if it made the outer diameter small, elongation
rd drawn copper wire is remarkably small in quality of the material For this reason, this joint may be damaged,
the mechanical load by the external force of the oscillating shock produced during an automobile run joins a
even if it carries out sticking-by-pressure junction of between terminals using hard drawn copper wire. Thus, if
ing-by-pressure junction of between terminals is carried out using hard drawn copper wire, the terminal sticking-
essure part would become the mechanical weak point section, and the result of being scarce will be invited to
ility that it is easy to produce an open circuit by the external shock.
7] moreover, the thing for which the operating weight of the electric wire for automobiles is made small -- a
uctor -- although it is realizable by making a path small, if it is in the conventional **** hard drawn copper wire --
.ductor -- if an outer diameter is made small, a mechanical strength will fall then, recent years and a conductor --
if it makes an outer diameter small, a mechanical strength can be secured and a copper alloy, a Mg-P copper alloy,
which contain Sn as a copper alloy which has comparatively good repeat crookedness intensity and conductivity
vented

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ECT OF THE INVENTION

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ect of the Invention] According to this invention, the open circuit by the crookedness in the pressure-connection-inal section can be decreased with high intensity to a mechanical shock, without causing the sharp decline in luctivity.

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CHNICAL PROBLEM

blem(s) to be Solved by the Invention] The copper alloy containing this Sn raises tensile strength and elongation by ing Sn dissolve in a copper matrix. However, the copper alloy containing this Sn has the trouble that sufficient ibility to be able to bear the mechanical load by external force, such as an oscillating shock produced during an mobile run, is not enough.

09] Moreover, a Mg-P copper alloy raises tensile strength and elongation by depositing the intermetallic compound fg-P in a copper matrix, without reducing conductivity greatly. However, this Mg-P copper alloy has the trouble sufficient flexibility to be able to bear the mechanical load by external force, such as an oscillating shock produced ng an automobile run, is not enough.

0] Without causing the sharp decline in conductivity, to the mechanical shock, this invention is high intensity and at offering the conductive Koriki copper alloy excellent in the flexibility which can decrease the open circuit by rookedness in the pressure-connection-terminal section.

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.ANS

:ans for Solving the Problem] the conductive Koriki copper alloy which was excellent in the flexibility of this :ntion in order to attain the above-mentioned purpose -- setting -- Sn -- 0.4 - 1.2wt% and Ag -- 0.1 - 1.0wt% and In .1 - 0.8wt% -- it contains and the remainder constitutes with copper fundamentally

12] That is, in order to attain the above-mentioned purpose, in the conductive Koriki copper alloy excellent in the ibility of this invention, Sn is made to dissolve in a copper matrix, tensile strength is improved by this, flexibility is ed without reducing conductivity sharply by adding Ag and In, and elongation is also raised.

13] In this invention, the content of Sn was made into 0.4 - 1.2wt% for reducing conductivity sharply, when the ct that the content of Sn raises tensile strength less than [0.4wt%] is small and the content of Sn exceeded 1.2wt ó.

14] Moreover, if the effect that the content of Ag raises tensile strength and flexibility less than [0.1wt%] was ll and the content of Ag exceeded 1.0wt(s)%, while fluidity would get worse, in this invention, the content of Ag made into 0.1 - 1.0wt%, because it became cost quantity.

15] Furthermore, in this invention, the content of In was made into 0.1 - 0.8wt% for reducing conductivity sharply, n the effect that the content of In raises tensile strength, elongation, and flexibility less than [0.1wt%] is low and :ontent of In exceeded 0.8wt(s)%.

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OPERATION

[Function] If the conductive Koriki copper alloy excellent in the flexibility constituted as mentioned above is used, conductivity can have conductivity almost equivalent to the conventional conductive Koriki copper alloy.
[0017] Moreover, if the conductive Koriki copper alloy excellent in the flexibility constituted as mentioned above is used, tensile strength has about 1.3 or more times and the fast strength of a hard steel, and even if it compares with the conventional conductive Koriki copper alloy, it can be raised a little.
[0018] Furthermore, if the conductive Koriki copper alloy excellent in the flexibility constituted as mentioned above is used, although elongation becomes smaller than annealed copper, it has the elongation of 6 times or more as compared with the hard steel, and can obtain annealed copper and the recurrence crookedness intensity more than equivalent. Furthermore, even if it compares elongation with the conventional conductive Koriki copper alloy, it shows the improvement in some.
[0019] And since it described above, when the conductive Koriki copper alloy excellent in the flexibility constituted like this invention is used for the electric wire for automobiles, the property suitable for the conductor of the electric wire for automobiles can be acquired, and the open circuit by a **** load and crookedness in reservation of the mechanical strength to whether a fuselage outer diameter is small and a terminal sticking-by-pressure part can be decreased. Therefore, it is suitable if the conductive Koriki copper alloy excellent in the flexibility constituted as mentioned above is used as a lead wire rod of the conductor of the electric wire for the wiring in electronic equipment and a semiconductor etc.

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AMPLE

ample] Hereafter, the concrete example of the invention in this application is explained as compared with the vention example.

1] As an example of this invention, with the fusion furnace maintained at inert gas atmosphere, after dissolving per under graphite grain covering, Sn, Ag, and In were added with the gestalt of a pure metal, the uniform molten al was obtained, and the casting rod of 20mmphi of composition of **** each example which shows this in Table 1 ontinuous casting was created. the electric furnace of the inert gas atmosphere after setting these to 1.0mmphi by rolling and the wire drawing -- using -- 280 degrees C -- 2 hours -- it heat-treated Then, tensile strength, gation, conductivity, and recurrence incurvation intensity were measured. The example of comparison is also nded on the same manufacture method.

2] In addition, as shown in drawing 1 , the incurvation examination pinched the test specimen 2 to the fixture 1, ated a recurrence deed and its number of times, and was made into incurvation intensity until it fractured stration A) ->(B) ->(C) -> (D) and 90 degree [of right and left] bending as 1 time to drawing 1 , where the tension W of 2kg is applied for the other end.

3] In order to clarify the feature of the conductive Koriki copper alloy excellent in the flexibility concerning this ntion, together with the example, composition of the example of comparison and the conventional example and hted solidity are shown in Table 1.

4] In addition, although composition of the alloys No3-No5 of the example of comparison is the same as that of el, Si, In, Sn, and this invention, the content of each composition differs from this invention.

5]

le 1]

	No	Sn	Ag	In	Mg	P	Cu	(%IACS)	(kg/mm^2)	(%)	度(回数)
実施例	1	0.47	0.46	0.75	−	−	残	47	64	5.6	42
	2	0.62	0.32	0.54	−	−	残	48	61	4.9	40
	3	0.85	0.86	0.18	−	−	残	48	60	5.2	41
	4	0.98	0.54	0.47	−	−	残	46	62	5.3	41
	5	1.14	0.18	0.23	−	−	残	45	65	5.0	40
比較例	1	1.38	−	−	−	−	残	45	55	2.4	34
	2	0.32	−	−	0.49	0.21	残	55	57	5.8	33
	3	1.68	0.36	0.78	−	−	残	36	68	4.9	40
	4	0.86	0.03	0.46	−	−	残	48	57	4.5	35
	5	0.64	0.61	0.03	−	−	残	51	60	4.1	35
従来	硬銅	−	−	−	−	−	残	98.3	49.8	0.9	19
	軟銅	−	−	−	−	−	残	100.3	23.3	27.3	41

6] According to this invention, tensile strength can be raised by making Sn dissolve in a copper matrix so that ·ly from comparison with the example (No1-No5) of Table 1, and the example of comparison (No1-No5).
7] Moreover, since Ag and In are made to dissolve in Cu host phase according to this invention, tensile strength, an gation property, and flexibility can be raised by leaps and bounds by dissolution of Ag to the inside of this Cu host e, and In, without reducing conductivity. although there is a fall as compared with the example of comparison :) by Ag and In to which this conductivity dissolved in Cu host phase -- more than about 45%IACS -- securing -- le strength -- a hard steel -- markedly -- improvement (about 1.3 times of a hard steel) -- it can carry out -- rence incurvation intensity -- ****** -- equivalent improvement is shown, and if it results in a pace of expansion, alue equivalent to the twice of the example of comparison (No1) and the example of comparison (No2) is Thus,

conductive Koriki copper alloy excellent in the flexibility concerning this invention IACS is shown about 45%, el rather than the example of comparison (No1), and it sets to tensile strength. conductivity -- setting -- the example omparison (No2) -- being also inferior -- It excels from the example of comparison (No1, No2), in elongation, a perty equivalent to the example of comparison (No2) is shown, and if several steps excel and it results in recurrence nsity from the example of comparison (No1), from the example of comparison (No1, No2), it has the property ch was excellent several steps, and has the property equivalent to very good annealed copper.

28] therefore, the property to which the conductive Koriki copper alloy excellent in the flexibility concerning this ention was suitable for the conductor of the electric wire for automobiles -- having -- a conductor -- small [of an r diameter] and the mechanical strength corresponding to lightweight-izing can be secured, and the open circuit by tension and the crookedness in the pressure-connection-terminal section can be decreased It is suitable if the ductive Koriki copper alloy which was excellent in the flexibility constituted as mentioned above from this is used lead wire rod of the conductor of the electric wire for the wiring in electronic equipment, and a semiconductor etc.

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SCRIPTION OF DRAWINGS

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ef Description of the Drawings]
wing 1] It is drawing showing the incurvation test method of the example of this invention and the example of parison, and the conventional example.
scription of Notations]
..... Fixture
..... Test specimen

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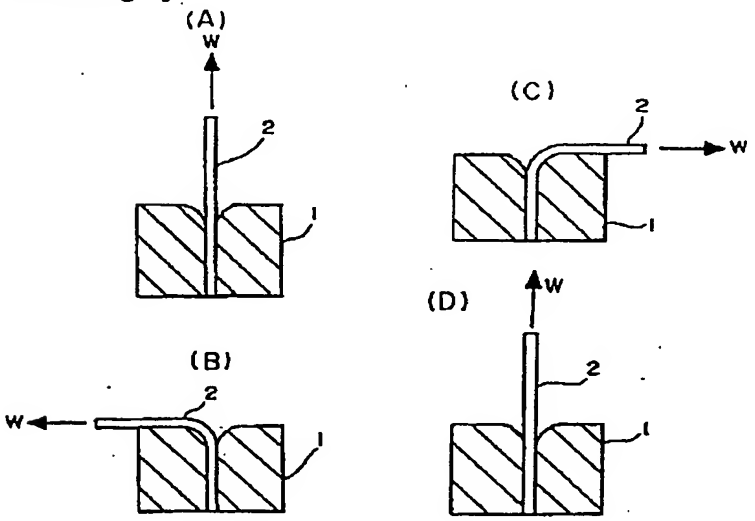
DRAWINGS

[Drawing 1]



[Translation done.]

Examiner's Copy

AN 2000:412389 HCAPLUS
DN 133:33391
TI Extremely thin copper alloy **wire** having high strength and its manufacture
IN Ichikawa, Masamitsu; Sawamoto, Takehito; Sugiyama, Shuichi
PA Fujikura Ltd., Japan
SO Jpn. Kokai Tokkyo Koho, 4 pp.
CODEN: JKXXAF
DT Patent
LA Japanese
FAN.CNT 1

PATENT NO.	KIND	DATE	APPLICATION NO.	DATE
PI JP 2000169918	A2	20000620	JP 1998-346223	19981204

AB The extremely thin Cu alloy **wire** contains 0.05-2.0% Ag and has tensile strength .gtoreq.35 kg/mm2. A Cu-(0.05-2.0%)Ag alloy **wire** material is drawn at .gtoreq.50% draft and coated with an insulating material under heating at 200-400.degree..